IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA,	)	
	)	
Plaintiff,	)	
	)	
v.	)	**Case No. 05-cv-329-GKF(PJC)**
	)	
TYSON FOODS, INC., et al.,	)	
	)	
Defendants.	)	

DECLARATION OF BERNARD ENGEL, Ph.D.

I, Bernard Engel, Ph.D., hereby declare as follows:

1. I hold a B.S. and M.S. in Agricultural and Biological Engineering from the University of Illinois and a Ph.D. in Agricultural Engineering from Purdue University. I am a registered professional engineer (PE) in the State of Indiana. Since 1988, I have been a faculty member in the Purdue University Department of Agricultural and Biological Engineering. I am currently Department Head and Professor within this program. My research, teaching and outreach expertise are in environmental engineering and the application of information systems technologies to environmental problems. I have extensive experience in developing and applying computer models, databases, and geographic information systems to a range of environmental issues. In this regard, I have developed hydrologic/water quality models and decision support systems that are widely used by consultants and local, state and federal agencies. My work has allowed me to obtain extensive experience in applying models and information technologies to assess nutrient and pesticide movement in surface waters of watersheds and into watershed groundwater. I have published more than 100 articles on related topics in peer reviewed scientific journals.

2. I have been retained by the Oklahoma Attorney General to evaluate the generation and land application of poultry waste within the Illinois River Watershed ("IRW"). In addition, I have been asked to evaluate the movement of this waste and its constituents into streams, rivers, and groundwaters within the IRW and into Lake Tenkiller.

3. On May 22, 2008, I submitted an Expert Report to the Defendants in the above-captioned litigation. Included in the Expert Report are my findings and opinions regarding poultry waste and phosphorus (P) generation in the IRW.

4. The following data, statements and opinions in this Declaration are taken verbatim from my May 22, 2008 Expert Report, pp. 28 and 93.

EXHIBIT
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5. WWTP contributions of P to the Illinois River for three time periods are shown in Table 6.1. Changes in WWTP technology significantly reduced P contributions beginning in 2003 (from more than 204,000 lbs annually to a little more than 90,000 lbs annually). Recent P discharges from WWTPs were computed from recent WWTP discharge data (1999-2007 Permit Compliance System (PCS) data) from the Oklahoma Department of Environmental Quality and the Arkansas Department of Environmental Quality. WWTP discharges prior to 2003 were obtained from Gade (1998), representing P discharges for the 1990s through 2002. Nelson reported similar WWTP discharges of P for the Arkansas portion of the Illinois River for the late 1990s through 2006. Nelson observed a significant reduction in WWTP P discharges beginning in 2003. Discharges from Arkansas WWTPs represent the majority of WWTP P discharges into the IRW streams and rivers.

Table 6.1. WWTP Total P Discharge to Streams and Rivers within the IRW

WWTP	Mid 70s P Load (lb/yr)	Early 90s P Load (lb/yr)	2003-present P Load (lb/yr)
Springdale	70,841	95,128	25,112
Siloam Springs	23,014	22,046	29,638
Fayetteville - Noland	0	9,921	5,147
Rogers	41,515	47,619	16,206
Lincoln	1,767	2,646	2,336
Prairie Grove	2,409	2,646	3,285
Tahlequah	19,235	10,362	2,738
Stillwell	15,675		2,519
Westville	2,502	6,393	840
Gentry	1,767	3,748	2,336
Watts		1,102	0
Midwestern nursery		1,323	0
Cherokee Nation		1,168	0
Stillwell Cannery			
Total	**178,724**	**204,101**	**90,155**

6. The P allocation to each source is shown in Tables 10.14 and 10.15. P loads from poultry waste application within the IRW represents 45% of P loads to Lake Tenkiller between 1998 and 2006. Following a change in WWTP technology that reduced WWTP P discharges, poultry waste application in the IRW was responsible for 59% of P loads to Lake Tenkiller for years 2003-2006.

Table 10.14. IRW P Load Allocation to Sources

	WWTP	Forest	Crop	Urban	Pasture
1998-2006	30	1	<1	7	62
2003-2006	15	1	<1	7	76

Table 10.15. IRW P Load Allocation to Sources

	WWTP					Pasture		
	Poultry	Nonpoultry	Forest	Crop	Urban	Cattle Near Streams Only	Poultry Only	Swine, Dairy, Background
1998-2006	10	20	1	<1	7	6	45	11
2003-2006	3	12	1	<1	7	6	59	11

WWTP discharges are the second largest contributor of P loads representing 30% of P loads between 1998 and 2006 (Table 10.14). A portion of the WWTP P load is attributable to poultry processing discharge to the Springdale WWTP as described in Section 6. Poultry processing discharges released by the Springdale WWTP represent 10% of total P loads to Lake Tenkiller between 1998 and 2006 and 3% of P loads between 2003-2006 (Table 10.15).

Pasture with swine and dairy waste application and background P from pastures is the third largest P load to Lake Tenkiller (Tables 10.14 and 10.15). Runoff from urban areas is the fourth largest contributor at 7% of P loads (Tables 10.14 and 10.15). Cattle in and near streams contribute 6% of P. However, this is almost all poultry P because cattle only facilitate the transport of P (discussion of cattle contributions follows in the next section). Other sources of P loads are responsible for 1% or less of P loads to Lake Tenkiller.

These results are consistent with other reports for the IRW (Section 2 of this report) and with studies for similar watersheds. The Draft TMDL for the IRW and Lake Tenkiller (USEPA Region 6 and Department of Environmental Quality State of Oklahoma, 2001) identified pastures on which poultry waste is applied as being responsible for 56% of P to Lake Tenkiller. Smith et al. (1997) indicated more than 78% of P loads in the IRW were attributable to livestock waste. Storm and White (2003) estimated that poultry waste was responsible for more than 49% of P loads in the Eucha Spavinaw Watershed that has similar conditions to the IRW.

I declare under penalty of perjury, under the laws of the United States of America, that the foregoing is true and correct.

Executed on the 29th day of May, 2009.

Bernard Engel, Ph.D., P.E.